

Spraying Practices for Iowa Orchards

By H. E. NICHOLS



Adapt the type of sprayer to the size of the orchard. Even in many small orchards, some type of power sprayer is the most efficient.

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SPRAYING SCHEDULE FOR APPLES AND PEARS



Fig. 1. Correct time for applying cluster bud spray. Note blossom buds are separated.



Fig 2. Petals have just dropped. Right time for calyx spray.

1. CLUSTER BUD SPRAY*

2. CALYX SPRAY

Time

Apply as the blossom buds separate and before they open.

Apply as soon as 95 percent of the petals have fallen and before the calyx of the young fruit closes.

Materials

Use 5 quarts of liquid lime sulfur (or 4 to 5 pounds of the dry form), plus $1\frac{1}{4}$ pounds of lead arsenate with water to make 50 gallons of mixture.

Use 5 quarts of liquid lime sulfur (or $3\frac{1}{2}$ to 5 pounds of the dry form), plus $1\frac{1}{2}$ pounds of lead arsenate with water to make 50 gallons of mixture.

Purpose

To control apple scab, bud moth, canker worm, curculio.

To control apple scab, first brood codling moth, canker worm, green fruit worm.

* By adding $\frac{1}{2}$ pint of nicotine sulfate to this spray, the plant lice (aphids) often present on the opening apple buds, may be controlled. Most of the aphids found on the opening buds of apple trees in Iowa belong to the species commonly known as the grain aphid (*Aphis avenae*). These live on the apple a short time and then migrate to other plants, so it seems doubtful whether it pays to try to control them, even though they do cause some damage. It is quite important, however, where aphids are found later in the summer on cherry, plum and young apple trees to control them by spraying with nicotine sulfate.

COVER SPRAYS*



Fig. 3. Shows size of fruit at time of applying first cover spray.



Fig. 4. Fruit is about this size when fifth and sixth sprays need to be applied.

FIRST BROOD CODLING MOTH SPRAYS

SECOND BROOD CODLING MOTH SPRAYS

Time

3. The first cover spray should be applied 10 to 14 days after the calyx spray.
4. Apply the fourth spray 2 weeks after the third or first cover spray.

5. Apply July 20 to 30 in southern Iowa, and July 25 to Aug. 5 in northern Iowa.
6. Apply 2 to 3 weeks after fourth spray.

Materials

Either $4\frac{1}{2}$ to 5 quarts of liquid lime sulfur (or 3 to 5 pounds of dry), or 3-3-50 bordeaux mixture, plus $1\frac{1}{4}$ pounds of lead arsenate with water to make 50 gallons of mixture.

Either 4 quarts of liquid lime sulfur (about 3 pounds of dry), or 3-3-50 bordeaux mixture, plus $1\frac{1}{4}$ pound of lead arsenate with water to make 50 gallons of mixture.

Purpose

To control first brood codling moth, scab and apple blotch.

To control second brood codling moth, apple maggot, scab and sooty blotch.

*Where the codling moth has not been destructive in years past, spray nos. 4 and 6 may be omitted. Sprays nos. 5 and 6 should not be applied on summer varieties of apples. The number of cover sprays necessary each season depends upon the abundance of pests and upon weather conditions. Growers should time the application of their cover sprays by the information furnished through the Orchard Spray Service of the Extension Service and sent out by the local county agents.

Spraying Practices for Iowa Orchards

By H. E. NICHOLS*

Efficient spraying practices are essential to profitable fruit production. In fact, spraying is usually considered the one orchard operation that pays the highest returns. The difference between success and failure in the orchard usually depends upon an efficient spraying program.

The bulk of the Iowa apple crop is produced in farm orchards. Perhaps half of these orchards are sprayed with varying degrees of success. Commercial growers are, as a rule, more thorough with their spraying, but many of them could profitably improve their methods.

SECURING RESULTS FROM SPRAYING

In order to obtain good results by spraying, the orchardist must: (1) Have a general knowledge of the pests to be controlled; (2) use a spray machine and other equipment adequate to the size of the orchard; (3) use the right spray materials; (4) apply sprays with sufficient pressure; (5) apply the necessary number of sprays; (6) apply them at the right time; (7) dilute them properly; (8) thoroughly cover the trees with the spray.

By following these directions satisfactory results should be obtained under ordinary conditions. It must be remembered that the results to a certain extent, will vary with the season and with local conditions.

ADDITIONAL APPLE SPRAYS

Under certain conditions, some of the following sprays may be necessary in addition to those given on pages 2 and 3.

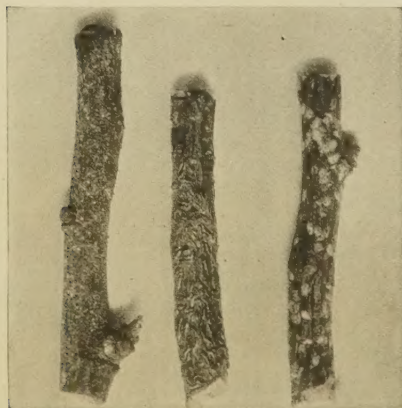


Fig. 5. Scale insects—left to right: San Jose scale, oyster shell scale and scurfy scale.

Dormant Spray

The dormant spray, applied just before growth starts in the spring, is necessary where there are severe infestations of oyster shell or scurfy scale and where the San Jose scale is found. The first two scale insects named are more commonly found in northern Iowa, but are also common in many places in the southern part of the state. The San Jose scale (by far the most destructive of the three) is mainly limited to certain counties in southeastern Iowa.

Control: Various materials may be successfully

* In cooperation with the departments of Entomology and Plant Pathology.



Fig. 6. Apple blight. Note blight black spots that are irregular in shape.

Southern Iowa on Northwestern Greening, Ben Davis and Missouri Pippin. Under Iowa conditions it usually can be controlled by applying two sprays, the first, 2 weeks and the second, 4 weeks after blossoming time. These coincide with the first and second cover sprays. Bordeaux mixture is usually favored over lime sulfur for blight control.

Apple blotch affects the fruit, the twigs and the stem of the leaf. On badly infested trees many of the twigs and smaller branches will be covered with small cankers. These cankers give the twigs a rough appearance.

The disease lives over winter in these twig cankers. About 2 or 3 weeks after blossoming time, the spores of the fungus are discharged from the cankers and drop upon, or are carried to the newly formed fruits. Those spores which find a place of lodgment on the fruit, germinate and cause the characteristic blotches as shown in fig. 6.

Apple Maggot or Railroad Worm



Fig. 7. Apple maggot or railroad worm. Note how the flesh has been tunneled by the larvae of this insect

used to combat the scale insects. Liquid lime sulfur, $6\frac{1}{4}$ gallons (or 12-15 pounds of the dry form) to 50 gallons of mixture is effective. There are now on the market various miscible oils and emulsions that may be used for scale control.

To control San Jose scale use $1\frac{1}{2}$ gallons of dormant spray oil to 50 gallons of mixture or follow the manufacturer's directions. Three to $3\frac{1}{2}$ gallons of the dormant spray oil to 50 gallons are necessary to control oyster shell or scurfy scale.

Apple Blotch Sprays

Apple blotch is common in

In recent years the apple maggot or railroad worm has caused serious damage especially in many northern Iowa orchards. The adult is a fly that deposits its eggs under the skin of the young fruit. The maggot, upon hatching, tunnels in all directions through the apple. It develops slowly in hard, immature fruits, but rather rapidly in fruits nearing maturity. The flies commence laying their eggs the latter part of June or the first of July and egg laying continues until fall.

Since the eggs are deposited under the skin of the apple, control measures must be aimed at the adult fly. Where this pest is serious it appears necessary to keep the surface of the fruit covered with a spray of lead

COMMON DISEASES INJURIOUS TO THE APPLE

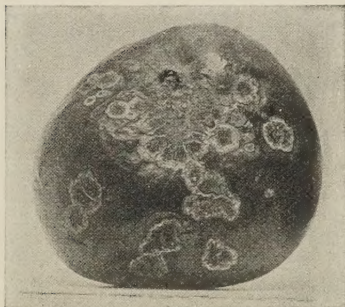


Fig. 8. Apple scab.



Fig. 9. Sooty blotch.



Fig. 10. Cedar rust.

arsenate. This requires several applications in addition to the regular spray schedule. The maggots leave the apple only after it has fallen to the ground, and pupate 2 or more inches under the surface. The destruction of all dropped apples is a distinct aid in the control of this insect. This can be accomplished either by turning hogs into the orchard in July and August or by gathering all dropped apples daily and burying them at least 2 feet deep.

Apple Scab

Figure 8 shows the typical spots produced on an apple by apple scab. Smaller brown spots may also be found on the leaves. The fruit usually becomes infected at blossoming time and the disease may develop throughout the season, depending on the amount of rainfall. During seasons of heavy rainfall, scab is serious. The cluster bud spray is applied mainly to control scab; later sprays also help hold it in check. Early infection usually malforms the fruit.

Sooty Blotch

This disease is variously known as sooty blotch, fly speck, or cloud. It develops late in the summer, after rains. It is confined to the surface of the fruit and while it does not seriously affect the keeping quality it does affect the appearance and selling qualities of the fruit. The late summer sprays usually hold it in check.

Cedar Rust

Figure 10 shows the typical yellowish spots of cedar apple rust on the leaves of the apple. To a more limited extent similar spots may be found on the blossom end or sides of the fruit itself. This disease lives both on the apple and on the redcedar tree. On the latter it makes the so-called cedar apples. Wealthy and Jonathan are more susceptible to this trouble than most other varieties in Iowa. Where redcedars are found near the orchard, cedar rust is usually present. For effective control remove nearby redcedars.

COMMON INSECTS INJURIOUS TO THE APPLE



Fig. 11. Green fruit worm.



Fig. 12. Aphis.



Fig. 13. Codling moth.

Green Fruit Worm

This large soft, green worm (fig. 11) does its damage soon after blossoming time. If the young fruit is badly eaten, it will drop. If only a small amount of the skin and flesh of the apple is eaten the fruit matures, but it is invariably injured to such an extent that it must be classed as second or cull grade. The second and third sprays easily control this worm.

Aphis or Plant Lice

The apple shoot in fig. 12 is covered with aphis. There are three different kinds, all of them green in color, that injure the apple. Brown colored aphis are often found on plums and cherries. Many other kinds are commonly found on a wide variety of plants. To control this insect it is necessary to get the spray in contact with each aphis. As they usually curl the leaves and are found on the under side of them, it is necessary to spray with nicotine sulfate before the leaves are badly curled.

Codling Moth

Codling moth is the most destructive insect attacking the apple and pear in Iowa. Normally, two broods develop each season. The insect lives over the winter in the larval or worm stage in a cocoon which is generally attached to the under side of the rough scaly bark. Many are found in harvesting equipment and in the packing shed. In early spring the larva changes to a pupa. Soon after blossoming time the adult moth appears; the exact time of appearance depends upon the spring temperatures.

During the past few years the first moths have emerged at Ames from about May 10 to June 10. These moths fly by night, and lay their eggs on the young fruit or on nearby leaves. The eggs are white, flat and about 1/25 of an inch in diameter. Normally 3 to 5 days elapse be-

tween the emergence of the moth and egg deposition. It takes about a week for the eggs to hatch. Nearly all of the first brood worms enter the blossom end of the fruit. The first worms enter the fruit about 2 to 4 weeks after blossoming, the exact time depending upon temperature and precipitation.

The larvae require 3 to 4 weeks to mature in the apple. When full grown, they leave the fruit and pupate under the loose bark of the tree. The second brood larvae (commonly called side worms) commence entering the fruit in southern Iowa by July 25 and about 2 weeks later in extreme northern Iowa. During some seasons the two broods are rather distinct, but for the past 7 years the first brood has been so irregular that larvae have been entering the fruit in greater or less numbers from early June until frost. Under such conditions, control can only be obtained by keeping the surface of the fruit covered with the spray.

Supplementary Control Measures. During recent years, codling moth control with spraying has been so difficult that many growers are now using other methods to reduce the codling moth population. Prominent among these are: (1) banding the tree trunks with either treated or untreated bands to trap the mature larvae, (2) keeping all harvesting equipment in tightly closed packing sheds to prevent the escape of the moth in early summer and (3) destroying all cull apples that have not been disposed of otherwise.

In banding the trees it is first necessary to scrape off all the rough scaly bark. This should be done during the winter and early spring months. In late June a triple layer of burlap about 6 inches wide should be fastened around the trunk about 12 to 18 inches from the ground. These bands must be removed about every 2 weeks and all worms killed. Recently chemically treated bands of corrugated paper have been very successfully used to trap and kill the larvae.*

SPRAYING STONE FRUITS



Fig. 14. Brown rot. The plums rot as they reach maturity. Such dried-up plums should be destroyed.

In spraying the home orchard, cherries and plums are usually sprayed after blossoming time along with the apples. As both fruits blossom before the apple and are usually in full bloom at the time of the apple cluster bud spray the cluster bud spray for plums should be applied earlier. This spray may be omitted for cherries.

Plums

A dormant spray is necessary on plum trees that have been affected with plum pocket during the previous season. Plum pocket is a fungous disease which manifests itself by enlarged, pale colored, hollow, deformed fruits. It makes its appearance soon after blossoming time and the affected fruits soon drop from the tree. It is

easily controlled by applying a dormant spray of 3 gallons of liquid lime sulfur to 50 gallons of mixture.

Brown rot, curculio and leaf spot are the most serious troubles of the plum. In order to obtain the best control of brown rot on plum, it is advisable to apply a spray at the time the flower clusters are

* For directions for making treated codling moth bands, write the Horticultural Extension Service, Ames, Iowa.

separating. Spray again just after the husks have fallen off the young fruit and again in about 2 weeks (same as the second and third sprays on apples). Use the same spray materials as for apples. In wet seasons, additional sprays applied 10 to 14 days apart will be necessary to control brown rot.

Cherries

Leaf spot, powdery mildew, curculio and pear slug are the most common troubles affecting the cherry in Iowa. Except in very few cases,

no spray is needed on the cherry until after blossoming. Apply a spray just after the husks drop off the newly formed fruit and again in 10 to 14 days as with the plum. Just after the fruit is picked apply a spray consisting of 4 quarts of liquid lime sulfur plus 1 pound of lead arsenate to 50 gallons of mixture.

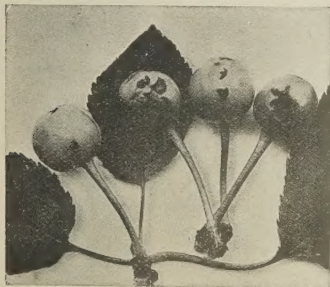


Fig. 15. Curculio. Egg laying punctures of plum curculio on cherries. It also attacks plums, peaches and apples.

Peaches

Brown rot, peach scab, leaf curl and curculio are the most destructive pests on peaches in Iowa. Just before the buds start to swell, apply a dormant spray consisting of 3 gallons of liquid lime sulfur to 50 gallons of mixture for peach leaf curl.

To control the curculio, apply a spray of lead arsenate, 1 pound to 50 gallons of water, to which 4 pounds of hydrated lime have been added, just as the husks have been shed from the newly formed fruit. Usually two sprays will keep brown rot and scab under control, one applied about 3 weeks after blossoming and another about a month before the fruit ripens. Use dry mix sulfur lime for scab and brown rot and as a control for curculio, add 1 pound of lead arsenate to each 50 gallons. Never use lime sulfur or bordeaux mixture on peaches after the leaves have developed, as they will cause severe burning.

MIXING AND APPLYING SPRAYS

In preparing the common lime-sulfur lead-arsenate spray, first weigh out the required amount of lead arsenate and mix into a thin paste in a separate container. Empty this into the sprayer when it is about half full of water. When the tank is nearly full, add the required amount of liquid lime sulfur. Stir thoroughly and apply at once. Never save any of the mixture for a later spray. Always add the lime sulfur last. Never mix the two materials in the concentrated form.

In the dormant, cluster bud and calyx sprays cover every part of the tree with the spray. In the later sprays cover every apple by spraying each part of the tree from two directions. Be thorough. More people fail from a lack of thoroughness than from any other cause. It usually requires from 4 to 6 gallons of diluted spray material to effectively cover a 20-year-old apple tree at each spray application, depending upon which spray is being applied, the capacity of the spray outfit, pressure and size of opening in the spray nozzle.

Young fruit trees and non-bearing trees should at least be sprayed at the time of the cluster bud and calyx sprays.

Spraying, to be effective, must be done at the right time. At each spray time there is usually 4 to 6 days when sprays can be effectively applied. Spraying too early or too late is a waste of time and materials.

SPRAY MATERIALS

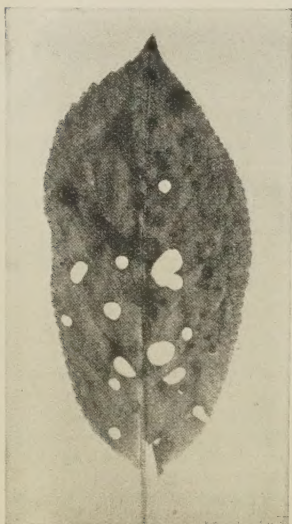


Fig. 16. Cherry leaf spot. Most common disease on cherry leaves. When bad, it will defoliate the tree in midsummer.

Lead Arsenate

Lead arsenate is the standard poison for killing leaf and fruit eating insects. Other poisons such as paris green and calcium arsenate should not be used on fruit trees as they may cause burning of the foliage.

Nicotine Sulfate

Nicotine sulfate is the most practical material used to control sucking insects such as plant lice (aphids). It can be added to other spray mixtures or can be used alone. When used alone, add enough soap to make the water sudsy (3 to 6 lbs. to 5 gal.). Nicotine sulfate is commonly used at the rate of 1 part to 800 parts of water, or $\frac{1}{2}$ pint in 50 gallons.

Lime Sulfur

Lime sulfur is more commonly used to control fungous diseases and scale insects than any other material. It is found on the market in two forms—liquid and dry. The liquid is the most economical form to use and is usually considered more effective. Frequently, however, the dry form is more easily obtained and more convenient, especially for the man with a few trees, and its use is reasonably satisfactory. It requires about 4 pounds of the dry form to equal a gallon of the liquid.

Commercial liquid lime sulfur usually tests 33 degrees Baume in density. All spray dilutions are based on this standard strength; if allowed to stand over winter or freeze they may lose in strength. The only way to be sure of the strength is to test with a lime-sulfur hydrometer. Dry lime sulfur is supposed to keep over winter if put in an airtight container and stored in a dry place.

Bordeaux Mixture

It is made of copper-sulfate (blue vitriol) lump or hydrated lime and water. The most common mixture is the 3-3-50 formula—3 pounds of copper sulfate, 3 pounds of lump (unslacked, or 4 to 5 lbs. of hydrated) lime, to 50 gallons of water. For some diseases bordeaux is more effective than lime sulfur. It is, however, apt to russet the fruit if used in the cluster bud and more especially the calyx spray on apples. Lime sulfur, on the other hand, is more liable to burn when the weather is hot. Hydrated lime may be substituted for lump lime, providing 50 percent more by weight is used. (Never use air-slaked lime.)

How to Make Bordeaux Mixture. First, make a stock solution of bluestone. Dissolve the bluestone at the rate of 1 pound to 1 gallon. Suspend the bluestone in a bag in a barrel with the required amount of water. The bottom of the sack should be only slightly immersed. Never use a metal container. Dissolve bluestone the day before spraying.



Fig. 17. A good type of barrel sprayer for use in farm orchards. The tower or platform aids materially in effectively spraying the tops of tall trees.

1. Add 3 gallons of bluestone stock solution to 40 gallons of water in spray tank.
2. Mix 5 pounds hydrated lime in enough water to make a creamy paste.
3. Add lime solution slowly while agitating mixture vigorously.
4. Add water to make 50 gallons.
5. Apply at once.

Dry Mix Sulfur Lime

This is a new spray material now used generally to control diseases on peaches and Japanese plums. It is used on plants that are susceptible to burning by lime sulphur and bordeaux. It is made by mixing, dry, 8 pounds of finely ground sulfur, 4 pounds of hydrated lime and $\frac{1}{2}$ pound of calcium caseinate or flour. Mix these into a thin paste with a little water and then dilute to 50 gallons.

ESTIMATING AMOUNT OF SPRAY MATERIALS TO BUY

It is always best to order enough spray materials in the spring to last through the one season only. Some materials deteriorate if kept over winter, but they may be kept with reasonable safety from one season to the next if stored in airtight containers. Liquid lime sulfur should be stored where it will not freeze.

In ordering liquid lime sulfur and lead arsenate for orchard spraying, buy 1 gallon of lime sulfur and 1 pound of lead arsenate for every two trees 20 to 25 years old. This will be enough for four to five sprays during the season. If the trees are small, estimate the number of them that it will take to equal one 25-year-old tree.

The dormant spray will require 0.6 gallon of concentrated liquid lime sulfur in addition to the above for the average sized tree.

If bordeaux mixture is used it will require $\frac{1}{3}$ pound each of copper sulfate and lump lime per tree per spray.

In buying nicotine sulfate order 1 pint for every 20 average sized trees that are to be sprayed.

DILUTION TABLE FOR SPRAY MATERIALS

| Name of material and strength | Number of gallons of diluted spray material | | | | | |
|---|---|----------|---------|-----------------------------|--------------------------|--------------------------|
| | 200 | 100 | 50 | 10 | 5 | 1 |
| Liquid lime sulfur, $6\frac{1}{4}$ gal. in 50 gal. Dormant spray strength | 25 gal.* | 12½ gal. | 6¼ gal. | 5 qts. | 5 pts. | 1 pt. |
| Liquid lime sulfur, 5 qts. in 50 gal. | 5 gal. | 2½ gal. | 5 qts. | 1 qt. | 1 pt. | 1/5 pt. |
| Liquid lime sulfur, 4 qts. in 50 gal. | 4 gal. | 2 gal. | 4 qts. | 1½ pts. | ¾ pt. | 1/6 pt. |
| Dry lime sulfur, 5 lbs. in 50 gal. | 20 lbs. | 10 lbs. | 5 lbs. | 1 lb. | ½ lb. | 1½ oz. |
| Dry lime sulfur, 4 lbs. in 50 gal. | 16 lbs. | 8 lbs. | 4 lbs. | 13 oz. | 6 oz. | 1¼ oz. |
| Dry lime sulfur, 3 lbs. in 50 gal. | 12 lbs. | 6 lbs. | 3 lbs. | 10 oz. | 5 oz. | 1 oz. |
| Lead arsenate, 1½ lbs. in 50 gal. | 6 lbs. | 3 lbs. | 1½ lbs. | 4½ oz. | 2¼ oz. | 2 tbsp. |
| Lead arsenate, 1 lb. in 50 gal. | 4 lbs. | 2 lbs. | 1 lb. | 3¼ oz. | 1½ oz. | 1 tbsp. |
| Bordeaux mixture, 3 lbs. copper sulfate, 3 lbs. lump lime, 50 gal. water | 12 lbs. 12 lbs. 200 gal. | 6-6-100 | 3-3-50 | 10 oz. 10 oz. 10 gal. | 5 oz. 5 oz. 5 gal. | 1 oz. 1 oz. 1 gal. |
| Nicotine sulfate (40%), ½ pint to 50 gal. (1 to 800) | 1 qt. | 1 pt. | ½ pt. | 3 tbsp. | 1½ tbsp. | 1 tsp. |

* This figure, in each case, denotes the amount of concentrated spray material needed to make the amount of diluted spray designated at the top of each column.